Measurements of neutron-induced fission cross sections of ^{205}Tl, ^{204,206,207,208}Pb and ^{209}Bi using quasi-monoenergetic neutrons of 35 MeV to 174 MeV.

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Nuclear data on intermediate energy nucleon-induced reactions are needed for the development of theory of nuclear interaction and nuclear structure. They also are necessary for the development of new concepts of nuclear energy production and transmutation of nuclear waste with the use of accelerators. Lead and lead-bismuth eutectics are regarded as prospective materials for spallation-based neutron production targets. For this reason, the neutron-induced fission cross section of ^{208}Pb in the energy range up to 200 MeV was included in the High Priority Request List for necessary measurements for accelerator driven system research [1]. In addition, fission cross section of ^{209}Bi is relevant as a secondary standard for neutron fluence measurements at intermediate energies.

Moreover, nucleon-induced fission cross sections for the spherical doubly magic nucleus ^{208}Pb and neighboring nuclei are of interest for development of accurate models of the fission process, because of possible manifestations of nuclear shell effects.

The cross sections for neutron-induced fission of ^{205}Tl, ^{204,206,207,208}Pb and ^{209}Bi were measured in the energy range from 35 MeV to 174 MeV using a multi-section Frisch-gridded ionization chamber. Such a detector has the advantage over ordinary parallel-plane ionization chambers that the discrimination of fission events against the background caused by light particles is better [2]. The neutron-induced fission cross section of ^{238}U was employed as a reference [3].

The measurements were performed at the neutron beam facility of the The Svedberg Laboratory in Uppsala, Sweden. A quasi-monoenergetic neutron beam with peak energies from 35 MeV to 174 MeV was produced using the ^{7}Li(p,n) reaction. The time-of-flight method was employed to discriminate fission events caused by "peak" neutrons from those induced by low-energy "tail" neutrons.

The neutron-induced fission cross section of natural lead, which is of great practical importance, has been obtained by summing the cross sections for the separate lead isotopes, weighted by the natural abundancies.

The data obtained are compared with the existing experimental data on neutron-induced fission cross sections of ^{nat}Pb and ^{209}Bi.

References:

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